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Historical anecdotes of fishing pressure: Misconstrued "sea serpent" sightings provide evidence for antecedent entanglement of marine biota in the British Isles

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Abstract

Marine scholars have come to realize the importance of including historical perspectives as part of comprehensive assessments made of the social–ecological systems involved in sustainable fisheries management. In particular, there is increasing recognition of the value in examining information contained within historical anecdotes as a prelude to implementing current conservation actions as well as setting future restoration objectives. The present study demonstrates that careful parsing of eyewitness accounts of unidentified marine objects which at the time were purported to be sea serpents—of the "many-humped" or "string-of-buoys" typology—actually reveals that marine fauna in the British Isles have been victims of entanglement in fishing gear for a much longer period than is customarily assumed. The temporal baseline for the onset of entanglement in this region certainly predates, by more than a century, the advent and widespread use of plastic in fisheries and other maritime operations.

KEYWORDS

by-catch, fishing gear, nineteenth century, UMOs

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1 | INTRODUCTION

Understanding social–ecological systems (SESs) through an historical lens ensures that environmental management will operate effectively. As Dearing et al. (2015) argue: "Without improved information on the long-term and complex interactions between causal factors and responses, it will be difficult to answer questions about trends, rates of change, tipping points, safe operating spaces and pre-impact conditions." Conservation biology needs such historical interpretations so its interpretations are considered complete and its proscriptions remain robust (Kittinger, McClenachan, Gedan, & Blight, 2015;

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Meine, 1999). Historical ecological research (e.g., Crumley, 1994) identifies attitudes and actions that have shaped current, and will influence future, SESs (Szabo & Hedl, 2011).

Those engaged in documenting the Anthropocene (e.g., Kittinger et al., 2015; Rick & Erlandson, 2008) face the challenge of backcasting the temporal period of reference from which to enable detection of the onset of deleterious change, a process that can benefit from the participation of social scientists (Ellis, Maslin, Boivin, & Bauer, 2016; France, 2016a). In particular, Dearing et al. (2015) show how archival documents—such as those used, for example, in the two early and seminal works by Moorehead (1966) and Mowat (1997)—can aid in reconstructing integrated regional histories about landscapes, ecosystems and resources. Historical ecology can help address the conundrum conservation biologists face posed by the "shifting baseline syndrome" (Jackson, Alexander, & Sala, 2011), wherein successive generations redefine that which is regarded as "natural" based on their own temporally truncated mindset and casual acceptance of a progressively depauperate natural world as the normal status quo.

Pauly (1995), who first popularized the expression, heralded the value of information contained within historical anecdotes for assessing the shifting baselines of fisheries. Schwerdtner Manez et al. (2014), concur, stating in their review that "witness testimonies, especially, are increasingly used to acquire information on past and contemporary marine environments and fisheries." Consequently, marine historical ecologists engaged in estimating the onset of anthropogenic change (McClenachan, Ferretti, & Baum, 2012) have made use of such qualitative information (Ferretti, Crowder, & Micheli, 2015) from non-traditional sources unrelated to fisheries and originally intended for other purposes (Al-Abdulrazzak, Zeller, & Pauly, 2015), including explorers' reports, travellers' diaries, naturalists' journals, fishers' observations and ethnohistorical records (e.g., Al-Abdulrazzak, Naidoo, Palomares, & Pauly, 2012; Early-Capistran et al., 2018; Johannes & Neis, 2007; Maschner, Trits, Reedy-Maschner, & Bretts, 2014; Saenz-Arroyo, Roberts, Torre, & Carino-Olvera, 2005; Saenz-Arroyo, Roberts, Torre, Carino-Olvera, & Hawkins, 2006). Understanding the "evolutionary framework" (sensu Dearing et al., 2015) of pre-anthropocentric baseline conditions is *de rigueur* for formulating both present-day management strategies as well as for setting future restoration goals in complex marine SESs (e.g., France, 2016a; Kittinger et al., 2015). A further benefit of using narratives in historical ecological research is that, as a form of didactic storytelling, it captures people's attention, providing reconnections to the social–ecological particulars of place (Mackinnon, 2015; Marzin, Evans, & Alexander, 2015), and thereby generating the public engagement deemed essential towards developing and implementing conservation actions (Al-Abdulrazzak et al., 2015) and restoration strategies (France, 2008). The present study uses this approach through exploring anecdotal evidence for the antecedent entanglement of marine biota in the British Isles.

Entanglement of fauna in fishing gear, either that actively deployed or that abandoned and drifting about, is recognized to be an environmental problem of cardinal importance, with more than two hundred species suffering its consequences (Laist, 1997). Although often resulting in quick mortality from being by-catch, there are many instances documenting non-lethally entangled animals pulling trains of debris over extended distances of thousands of kilometres and prolonged timeframes of months or even years (Gardner, 2007; Johnson, 2005; Neilson, Straley, Gabriele, & Hills, 2009; Lyman *in* Anonymous, 2019a, 2019b; National Oceanic & Atmospheric Administration [NOAA], 2014); thus, despite the ensuing debilitations associated with infected wounds and the impeded mobility caused by rope abrasion and hydrostatic drag, both of which no doubt compromise long-term survival (Derraik, 2002).

Entanglement is widely believed to be a modern phenomenon corresponding to the advent and widespread use of plastic since the middle of the twentieth century (Nelms et al., 2015), with little or no occurrence before that time (NOAA, 2014), due to the assumption that materials consisting of hemp, cotton and other fibres will "lose their resilience in usage and if lost or discarded at sea [will] tend to disintegrate quickly" (Gregory, 2009). Because of this, it was only in the mid-1980s when ecologists began to recognize that fishing debris posed a serious threat to marine biota, as witnessed by a dearth of published literature before that time (Vegter et al., 2014). It is not surprising then, that in their comprehensive survey of 170 reports, NOAA (2014) found only a few articles on early, pre-plastic entanglement. Furthermore, in their referencing of another literature survey, which had found no records of entangled sea turtles before 1950, they opine that "the absence of entanglement records prior to 1950 could be from the low use of synthetic materials in fishing practices and land-based products."

Ropes and nets made of hemp or cotton always needed to be regularly repaired due to the constant cycle of soaking and drying, swelling from salt intrusion, physical stress and fatigue, weakening from sunlight and microbial activity (Bekker-Nielsen & Casola, 2010; Kristjonsson, 1971). Although it is certainly true that earlier ropes and nets would have deteriorated more rapidly than their modern-day synthetic equivalents, it is erroneous to suppose that such materials were not of sufficient durability as to justify their ubiquitous and continued maritime use (Goode, 1884; Wilcocks, 1884), nor their consequent ability to pose an entanglement threat to susceptible wildlife. Hemp actually becomes "stronger when wet and does not rot easily in water," owing to the hydrostatic nature of fibre (McCaskill, 2009). The tensile strength and longevity of wetted ropes can increase up to 20% and extend well beyond a year given proper treatment with preservatives (Aiken & Purser, 1936). Ropes were customarily impregnated with tar or soaked in tanning solution made from ash or oak bark to extend their longevity (Bekker-Nielsen & Casola, 2010; Cardamone, 2001; Hodgson, 1957; Kristjonsson, 1971), with abaca or manila hemp rising in popularity throughout the nineteenth century in consequence of containing natural oils that accomplished the same preservation (McCaskill, 2009). In some cases, hemp ropes were even reinforced with braided wire (Goode, 1884).

Because they are neither as strong nor as elastic as today's nets made of synthetic materials, those constructed from natural fibre would have enabled a higher proportion of animals to escape

capture, possibly pulling entangled gear behind them as a legacy of their near brush with death. Indeed, the sea serpent literature is filled with accounts documenting that strong swimmers such as recognized cetaceans, pinnipeds, large fishes or unknown "monsters" could muscle their way through gillnets made of cotton twine or hemp, sometimes, in the process, making off with portions of the net and its accompanying floats in tow. The result of all this is that early non-lethal entanglement may have lasted, if not for half a decade or longer as can be the case today due to use of non-degradable plastic, at least for durations of months and possibly even several years. This is more than sufficient time for the so-encumbered and unfortunate animals pulling long trains of debris to be observed and misconstrued as being what cryptozoologists examining historical anecdotes customarily refer to as the archetypical "many-humped" or "string-of-buoys" category of sea serpent (Heuvelmans, 1968).

Bolster (2012, p. 91), in his comprehensive history of the North American fisheries, made the assertion that "no marine environmental historian worth his or her salt can afford to ignore … nineteenth-century sea serpents." Indeed, eyewitness accounts about sea monsters can provide insight about the history of human–nature relationships (e.g., Brown, 1990; Lyons, 2009; Paxton & Naish, 2019). For example, careful parsing of the words contained within anecdotal accounts of sightings of unidentified marine objects (UMOs), which at the time had been purported to be sea serpents, generates data, *à* la Paxton (2009), of relevance to concerns of contemporary conservation biologists (Parsons, 2004). In particular, textural records by laypeople provide surrogate information that marine animals have been subjected to anthropogenic pressure, not just from direct fishery mortality as has been previously noted, but also through a consequence of being non-lethally entangled in fishing gear. Previous work has advanced this illation for the taxa of cetaceans (France, 2016b, 2018), chelonians (France, 2016c, 2017) and fishes (France, 2019a, 2019b), as well as for the regions of New England (France, 2019c), Atlantic Canada (France, 2020a) and the Western Pacific (France, 2020b).

Two sightings of UMOs that occurred within the Scottish Hebrides went on to garner considerable worldwide attention: that of the "Soay beast" in 1959, which became one of the most discussed "sea monsters" in the second half of the twentieth century (Brongersma, 1968), and that of the creature observed from the vessel *Leda* in 1872, which has been described as "the most detailed account of a sea serpent encounter" in the British Isles (Harrison, 2001, p. 153). Based on information purveyed within the anecdotal descriptions and accompanying illustrations from eyewitnesses (see France, 2017, 2019b), there is a high likelihood that both of these pertain to animals that were entangled in fishing gear. The purpose of the present investigation was to expand examination of the corpus of UMO sightings to include those from the entire region of the British Isles and over a period of two centuries, to see whether there is compelling evidence for what would be, if so demonstrated, the earliest examples of non-lethal entanglement in European waters. Accomplishing this would demonstrate that entanglement has a much longer environmental history than is commonly believed, and would provide another example in recognizing the antecedence of past fishery pressures.

2 | BACKGROUND AND HISTORICAL SOURCES

2.1 | The study region

The substantial threat posed to marine wildlife in the British Isles by incidental by-catch and entanglement has been recognized for decades (e.g., Allen, Jarvis, Sayer, & Mills, 2012; Cosgrove et al., 2016; Leeney et al., 2008; Northridge et al., 2010; Parsons et al., 2010; Tregenza, Berrow, Hammond, & Leaper, 1997). It is the present contention that given the long history of fishing in this region, these problems are unlikely to be new phenomena.

Fishing equipment has been cast, set or dragged within the waters surrounding the British Isles for centuries (Fagan, 2017; Hoffman, 2005; Starkey et al., 2000; Sicking & Abreu-Ferreira, 2009; Thurston, Hawkins, & Roberts, 2014; Tittler, 1977). By the time of the late 1900s, a wide diversity of fishing nets made from hemp cordage and flax-twine mesh was strung along these coastlines (Figure 1). Net buoys during the nineteenth century shifted from being blown-glass balls to larger cork floats and wooden casks (Figure 2). Modest seines, gillnets and baited hooks were deployed from small boats (Hodgson, 1957; Samuel, 1918; Wilcocks, 1884), resulting in a "rat's nest of lines" (Bolster, 2012, p. 124). In consequence, by the end of the nineteenth century, an obstacle course of deployed fishing gear existed along the coastline of the British Isles, which posed a threat to permanently entrap or temporarily entangle megafauna.

Nets were also purposely set to deliberately catch basking sharks (Fairfax, 1998), an animal whose scientific name (*Cetorhinus maximus*, Cetorhinidae) denotes "pointy-nosed monster of great size"; that is, the first part of the genus name *Ceto* is derived from the Greek *ketos*, meaning marine monster, from which the word "cetaceans" is derived, whales having had a long history of being likened to sea monsters (Hendrikx, 2018; Szabo, 2008). It is worth noting that no species has been more frequently misconstrued as being sea monsters than basking sharks (France, 2019c, 2020b; Maxwell, 1952; Speedie, 2017). There was also a contemporaneous commercial fishery that involved hunting basking sharks and cetaceans with thrown harpoons (Fairfax, 1998; Szabo, 2008), through a method called "kegging," wherein fishermen would attach a string of barrels or drums to the line in order to create enough drag to hinder prey. Moreover, it is estimated that fully a quarter of all whales struck with hand-thrown harpoons actually managed to evaded capture (Mowat, 1997), as witness to an account by polar explorer Fridtjof Nansen which details how he lost three intertwined ropes with their accompanying large casks to an escaping whale (see France, 2016a).

The working premise herein is that if Alverson, Freeberg, Murawski, and Pope (1994) and a senior NOAA scientist interviewed by Deedy (2017) are correct, and by-catches and non-lethal entanglement have both existed ever since fishing began and humans first

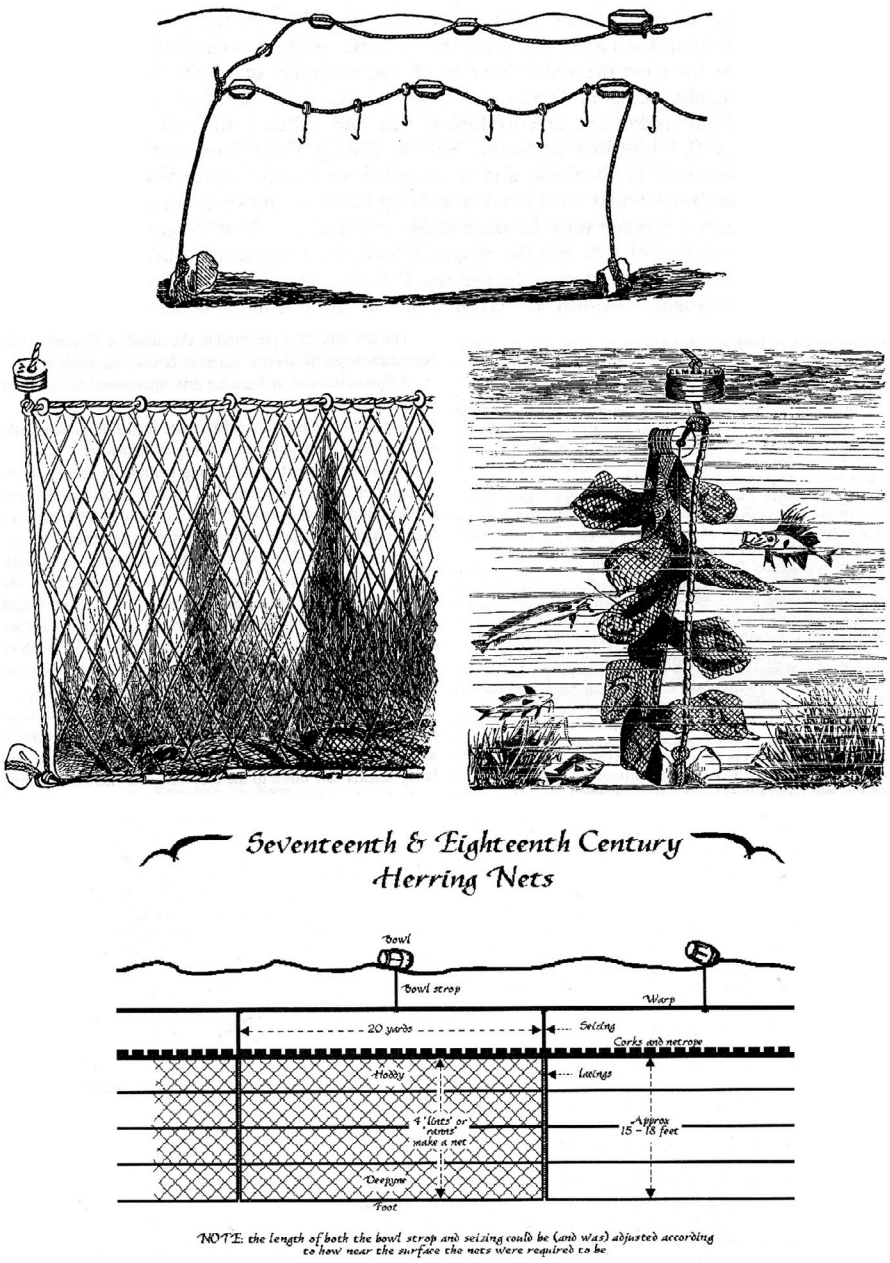
Seventeenth & Eighteenth Century
Herring Nets
Bowl
Bowl strop
Warp
20 yards
Seizing
Corks and net rope
Hoddy
Lacings
4 'lotes' or 'rants' make a net
Approx 15 – 18 feet
Deepyne
Foot
NOTE: the length of both the bowl strop and seizing could be (and was) adjusted according to how near the surface the nets were required to be

FIGURE 1 Fishing nets composed of hemp cordage, flax-twine netting, and cork and barrel floats, used in the British Isles during the seventeenth to nineteenth centuries, which would have posed a threat to entangling marine biota. Upper three images from Wilcocks (1884; reproduced in France, 2020a); and lower image—which clearly shows the two-tiered system of buoyancy for a "sunk net," with barrels on the surface warp line and corks on the submerged net rope—from an identified source (reproduced in Butcher, 2000)

hurled spears and floats into the waves and deployed nets in the water (Fagan, 2017), then it should be possible to detect their presence hidden in the words of eyewitness anecdotes of historical sea serpent sightings.

2.2 | The precedent for comparison

The illation that sightings of "sea serpents" from the British Isles might actually represent early observations of mundane marine fauna entangled in fishery equipment that went unrecognized at the time derives from a careful examination of the "Gloucester Sea Serpent" which frequented New England during the early nineteenth century. The theory that entangled animals were misconstrued as sea serpents has been endorsed by scientific experts and knowledgeable commentators as being a particularly meritorious explanation behind many UMOs (see Deedy, 2017).

The Gloucester UMO sightings hold a unique position in the annals of the natural history of sea serpents. Most sightings of UMOs, including those from the British Isles (Harrison, 2001), are made by a single eyewitness and occur for only a brief instance (Heuvelmans, 1968; Oudemans, 1892). The same cannot be said for the Gloucester UMO which was observed by hundreds of people, for durations of hours and over a time period of months and possibly years (O'Neill, 1999; Soini, 2010), such that it remains the most sighted "sea serpent" in history (France, 2019a). It cannot therefore be dismissed as mere hallucinations of a few, as was the case for the witches of Salem or the devils of Loudon. Clearly, people saw *something* in the water that was atypical to the norm, leading to the ensuing social phenomenon (Burns, 2014). The second singular

FIGURE 2 Blown-glass balls and carved cork used as floats during the nineteenth century (photographs taken at the Fisheries Museum of the Atlantic, NS, and provided courtesy of the Mystic Seaport Museum, CT (France, 2019a, 2020a)

feature of the Gloucester UMO is that it is the most thoroughly investigated "sea serpent" of all time (France, 2019a). The comprehensive interviews of eyewitnesses, undertaken under oath by authorities for the region's natural history society, give a semblance of authenticity to these accounts that is lacking among other sightings. Moreover, the UMO played a critical role in both the birth of American natural science and international discussions about the theory of evolution (Brown, 1990; Lyons, 2009). It is for these reasons that the Gloucester Sea Serpent has achieved an exalted status among cryptozoologists, being touted for providing “by far the best-documented evidence that sea-serpents exist” (Bauer, 2013). Because of this, there is a tradition of using the Gloucester sightings to imply an authority to bolster other, less well-documented claims of different UMOs (e.g., Gould, 1930). The great irony is that the Gloucester UMO does the exact opposite; that is, it provides the gold-standard test from which to reach conclusions that a not insignificant proportion of all observed cryptids, and certainly those repeatedly referred to in the literature as exhibiting “many-humped” or “string-of-buoys” characteristics, were actually animals pulling entangled fishing gear or other maritime debris (France, 2016b, 2016c, 2017, 2019c, 2020a).

The evidence that the Gloucester UMO was an entangled animal is very compelling (France, 2019a); no more so in this regard than through the frequent descriptions made of its body resembling a string of floats roped together and lying upon the surface of the water (Table 1). This is the "smoking gun" denoting that what was seen was almost certainly an entangled animal, that is the so-called "duck test" of abductive reasoning. Another dozen morphological and behavioural traits likewise bespeak entanglement. These include, for example, bodies of unusual length which are described as being extremely flexible and moving via vertical undulations, often accompanied by notable water disturbance; or, if not so moving, bodies described as being composed of distinct components which lie at rest floating upon the surface for considerable periods before suddenly being pulled down; and bodies described as being of serpentine shape and sometimes sporting accoutrements such as horns, spikes or a mane, all while displaying a peculiar obliviousness to surroundings or an imperviousness to physical disturbance (France, 2019a). It is important to keep all these attributes of the Gloucester UMO in mind when reading through the following accounts of UMOs from the British Isles.

2.3 | The anecdotal provenance

The main historical sources mined for anecdotes include the two authoritative texts known for their comprehensive listing of sea serpent sightings from the British Isles from the start of the nineteenth to the cusp of the twenty-first centuries: Heuvelmans (1968) and Harrison (2001). As per established procedure in popular cryptozoology (Heuvelmans, 1988; O’Neill, 1999) and academic scholarship (Burns, 2014; Cheezum, 2007; France, 2019a) on hidden aquatic animals, these two books contain accounts that have been compiled from hundreds of disparate sources, such as newspaper reports, magazine articles, legal sworn testimonials and scientific journal papers, in addition to incorporating those from the earlier, and similarly derived, seminal compendium of Oudemans (1892). In order to make the literature search as exhaustive as possible, other well-known general sources, including Gould (1930), Dinsdale (1966), Sweeney (1972), McEwan (1978), Coleman and Huyghe (2003), and Woodley (2008), were also surveyed, as well as dozens of nineteenth-century natural history books and journal papers referenced in Westrum (1979), Lyons (2009) and France (2019a).

A total of 214 UMO sightings for the British Isles over the period 1809–2000 were found to be of sufficient length and adequate description to enable them to be analysed. These included accounts corresponding to all nine of Heuvelmans’ (1968) putative categories of sea serpents/monsters: long-necked, merhorse, many-humped,

TABLE 1 Descriptions of the unidentified marine object, imagined to be a sea serpent, observed between 1815 and 1824 in Gloucester Harbor and elsewhere in New England and New York, and clearly indicative of a marine animal that was non-lethally entangled in fishing gear or other maritime debris (France, 2019a, 2019c)

"…his appearance in this situation was like a string of buoys. I saw perhaps thirty or forty of those protuberances and bunches, which were about the size of a barrel."
"…looked like the buoys of a seine."
"…with a good glass [I saw what] seemed like gallon kegs tied together."
"His body when out of the water looks like the buoys of a net, or a row of kegs, or a row of large casks."
"…of the size of a barrel about the body, which … are so prominent, that they resembled buoys attached to each other."
"[The body] appears in joints like wooden buoys on a net rope almost as large as a barrel, that the musket balls appear to have no effect on it, that it appears like a string of gallon kegs."
"…as he moved he looked like a row of casks following in a right line."
"He appears to be full of joints and resembles a string of buoys on a net rope, as is set in the water to catch herring. Others describe him as like a string of water casks … Two [musket] balls were thought to hit his head, but without effect."
"…resembled the link of a chain."
"The first view I had of him appeared like a string of empty barrels tied together, rising over what little swell of the sea there was."
"The back was composed of bunches about the size of a flour barrel, which were apparently about three feet apart … and looked like a string of casks or barrels tied together."
"The body, which is formed into parallel rings, which—when he is on the top of the water—are so prominent, that they resembled buoys attached to each other."
"…and to seem jointed, or like a number of buoys or casks following each other in a line."
"…the curvature and bunches on his back. To some he appeared jointed, or like a string of kegs or buoys connected on a rope."
"…giving the appearance of a long moving string of corks."

many-finned, super-otter, super-eel, marine saurian, father-of-all-turtles and yellow-belly. The eyewitness anecdotes were carefully parsed using the standard qualitative social science procedure of directed content analysis (Hsieh & Shannon, 2005). Emergent patterns were sought based on the grounded (Charmaz, 2000) or a priori ascription of assigned codes as textural anchors to indicate pertinent content. The particular coded words or phrases employed in this way as "search images"—to use an analogous term familiar to population biologists—were based on traits specifically identified for the entangled Gloucester UMO. These include 6 physical attributes: notable length; body composed of a series of irregular, jointed component parts (multiple humps, coils or a ridge); body components likened to kegs or barrels, and sometimes to scales or saucers; overall body likened to a string of floats, kegs or buoys; narrow, tapering, sinuous, snake/eel-like shape, often with an absence of a caudal fin or lateral appendages; and presence of a horn, spike, spine, mane of hair or other protuberance (sometimes identified as a head); and seven behavioural attributes: rapid speed of movement, notable flexibility of body, vertical undulating movement of body segments; oblivious of surroundings or impervious to disturbance; obvious trailing wake or water disturbance; floating motionless, gently swaying in waves or moving very slowly; and extended body pulled down into the water, thrown up into the air or thrashed about on the surface.

From the complete corpus of 214 sightings that were examined, the wording in a limited subset of 51 accounts (24%) suggested the observed UMOs to have been non-lethally entangled animals. Excerpts from the longer anecdotes are presented herein, divided and diachronically arranged within each of the three broad morphological categories of Body Shape, Body "Humps" and Body "Hair," and the two broad behavioural categories of Swimming Motion and Other Behaviours (which included imperviousness to assault, obliviousness to surroundings, inferred "conflicts" with other creatures and presence on dry land). In reality, and as elaborated upon below, individual anecdotes often (69% of the time) exhibited more than a single-coded attribute. In consequence, arrangement of anecdotes into the broad-scale categories below is for convenience sake (i.e., to break up what would otherwise have been a single lengthy chronological listing), the decision made as to where to place each anecdote based on the attribute that was most demonstrably described therein. A "composite cryptid" is assembled for discussion purposes through pooling the disparate anecdotal descriptions together to create an archetypal UMO. In no way should this fusion be interpreted as implying that these geographically distinct and temporally separated sightings correspond to the same individual or even the same species of entangled animal misconstrued as "sea serpents." Instead, this summarizing approach merely provides a convenient manner from which to compare salient characteristics for the generic UMO for the British Isles with those derived similarly for the Gloucester Sea Serpent (France, 2019a) and UMOs for other geographic regions (France, 2019c, 2020a, 2020b).

3 | EYEWITNESS ACCOUNTS

3.1 | Body Shape

At an unspecified date, "an enormous worm" was observed on the west coast Scotland "rolling on the surface" of the water. The UMO had a "head (if it was a head) [that] was quite unlike any seal's and had no face or nose, nor eyes" *[Anecdote 1]* (Harrison, 2001, p. 144). Similarly, a 15- to 25-m UMO seen in 1882 "skimming along the surface of the sea" in south-west England was described as having an elongated body that "scarcely looked like a tail. It seemed more like a curl in some long thin monster" *[Anecdote 2]* (Harrison, 2001, p. 109). This may be the same, many-humped, creature seen several weeks later in Wales (Figure 3). In 1892, the crew of fishing boat off the east Scottish coast spotted a 13-m UMO with a head that was "large, round and of a brownish-black colour" and that "which he took to be the tail of the serpent,

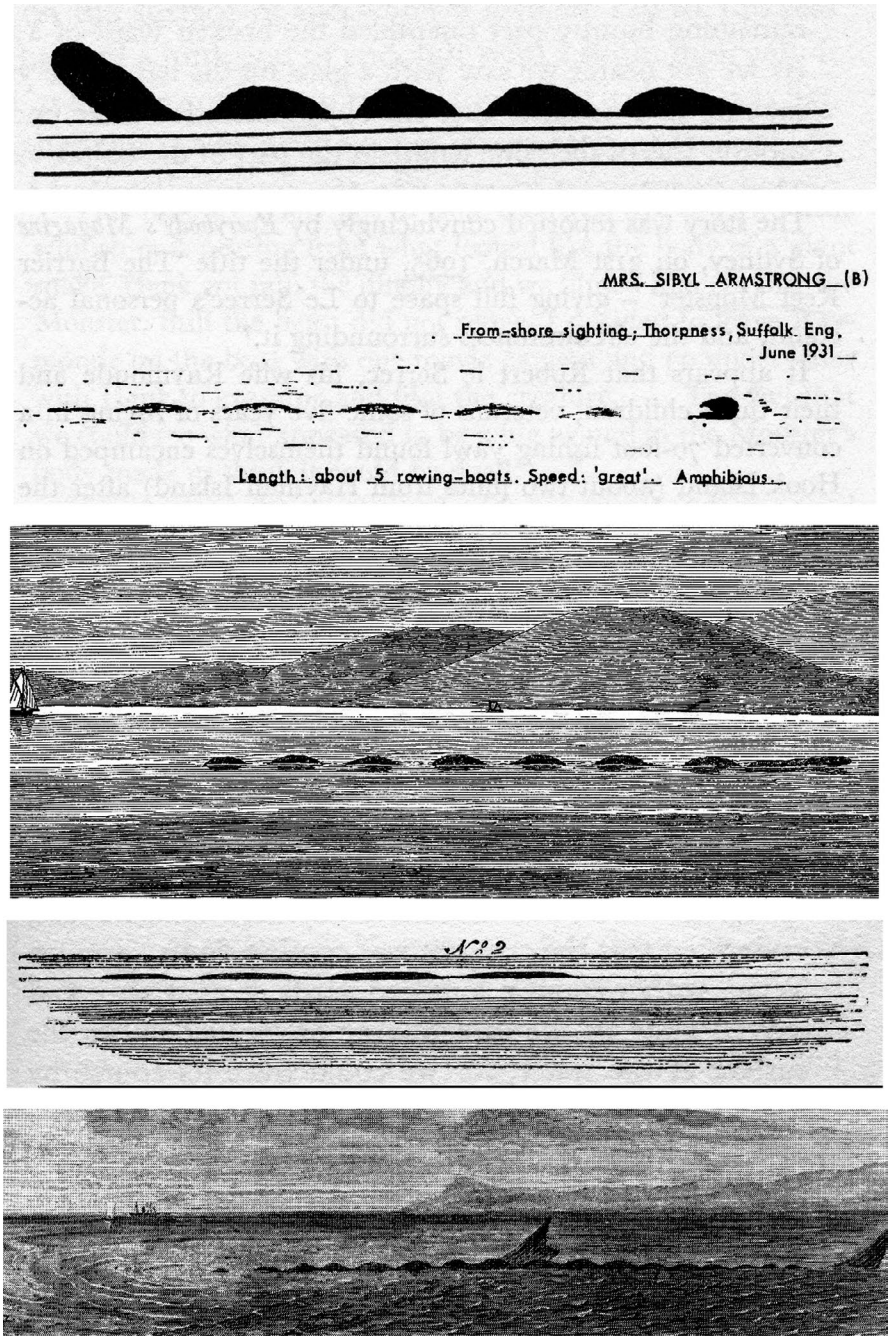
MRS. SIBYL ARMSTRONG (B)
From-shore sighting; Thorpness, Suffolk. Eng.
June 1931
Length: about 5 rowing-boats. Speed: 'great'. Amphibious.
No 2

FIGURE 3 Unidentified marine objects seen in the British Isles and interpreted as either being the "many-humped"/"string-of-buoys" typology of sea serpent or *actual* strings of fishing floats pulled behind entangled animals. From top to bottom: 1882 sighting from Orme's Head, Wales (Anecdote 50; Heuvelmans, 1968); 1931 sighting from Thorpeness, Suffolk (Anecdote 2; Dinsdale, 1966); and 1872 and 1882 sightings from the *Leda* (two views) and the *Kätie* in the Scottish Hebrides (France, 2019b)

twisting and coiling itself above the water. It was of a slatey blue colour, lightening towards the end of the tail, until at the tip it was quite white" *[Anecdote 3]* (Harrison, 2001, pp. 195–196). Another eyewitness described the tail as wriggling about and the body being covered with large scales. An UMO, described as "a long black line on the surface about nine or ten feet long," and referred to by Harrison (2001, p. 63) as "an archetypal sea serpent," was seen off the North Sea coast of England in 1960 *[Anecdote 4]*. And in 1994, at a time when fishing gear was made of synthetic material, in response to a shout of "Look, the Loch Ness monster," several people observed a serpentine creature "measuring about 1 ft in circumference, with no visible head" making its way along the west coast of the country *[Anecdote 5]* (Harrison, 2001, p. 114).

3.2 | Body "Humps"

A 30-m-long, 0.5-m-wide UMO was observed off the west coast of Scotland in 1873:

> Undulating portions of the body [were seen] above the surface … Sometimes it appeared to stretch itself out to its full length, at which time both its head and tail were seen above water, only a small portion of the middle of the creature being submerged. Most frequently, however, it was the undulations or apparent coils of the body that were observed, two or three of them being occasionally visible at the same

> time. The foils [i.e., structures in the shape of curved arches used in gothic tracery] had all the appearance … of the coils or folds of a serpent, the sea and black masses being distinctly separated. *[Anecdote 6]* (Harrison, 2001, p. 135).

Fourteen years later, two naturalists on a yacht sailing the west coast Scotland spotted a 20-m-long UMO with "a very low flat head" followed by "a gap" of more than a metre and then "ten 'hummocks' increasing in bulk and altitude towards the central one, but not much—gaps not so great as the size of the hummocks, next a space, about equal to two hummocks, then three hummocks the central the largest, the last small" *[Anecdote 7]* (Heuvelmans, 1968, p. 291). The UMO was observed both swimming and floating at rest, the latter followed by its sudden submergence and subsequent re-emergence which "were both without the *least* splash; but at the moment of disappearance the second time *the foremost two of the last three hummocks coalesced into one*. [original use of italics]." Using his binoculars, the observer noted that he "distinctly saw water falling … between some of the hummocks … [and that] there was no consecutive filling up of the interspaces whatever, or appearance of vacuities where the hummocks had but now been." The eyewitness concluded by remarking that "setting aside the quiescent low head, *I did not see a solid substance at all*,—except when the tail hummocks momentarily appeared … I cannot set the 'hummocks' down to *surge waves* of a rushing short fish; because I cannot so explain such surges being always the same both in *number* and in *place*: nor can I explain the appearance of an apparently solid head—and an apparently continuous tail." An independent eyewitness provides another account of the same sighting (Heuvelmans, 1968, p. 292):

> I counted with the binoculars twelve or perhaps thirteen humps at almost perfectly regular distances the one from the others. The first of these humps appeared to be moving rapidly through the water across the line of vision, and to be breaking and spraying water, and the other eleven or twelve … maintained all their relative positions with one another and collectively with the first, *yet* did no appear in themselves to me to move … The whole disappeared and reappeared at least four times to me, apparently simultaneously or almost so throughout its length.

Next, in 1895, were several sightings from the western Scottish islands, in which specific reference was made to a "sea-serpent" between 20 and 40 m long "showing two 'coils' 10 feet apart" with "three joints of its body … fitting into each other like the joints of a lobster's tail" *[Anecdote 8]* (Heuvelmans, 1968, p. 362).

Sightings of similarly described UMOs took place in the twentieth century before the Great War. In 1906, off the Devon coast, one observer noted that an UMO "having serrated edges" along its back "wriggled past his boat" *[Anecdote 9]* (Harrison, 2001, p. 91). As reported in *The Times* of 1933, at the height of the Loch Ness monster sightings, an individual commented that back in 1907, along the Cornish coast, he saw a 15-m-long UMO that had a smallish head followed by "a space of water and a long series of small humps, [each] separated by spaces of water" *[Anecdote 10]* (Harrison, 2001, p. 107). During an outing in the same region in 1911, observers saw a "thing" which "stretched itself out in an undulating coil, lashing the water. We calculated its length from 60 to 90 feet, and its head did not appear. The body was round, and about the size of a 30-gallon cask. Almost black fins, with short intervals, ran the entire length of its back" *[Anecdote 11]* (Harrison, 2001, p. 110). Heuvelmans (1968, p. 388) describes what happened next: "The thing with its strange crenellated back—or were they humps?—made off … leaving a wake of foam and showing three or four coils of its body at a time." And the following year, this time on the East Anglia coast, H. Rider Haggard's daughter and a companion were excited when they saw a 20-m-long "sea serpent" that "looked like a thin, dark line with a blob at one end, shooting through the water at such terrific speed it hardly seemed like anything alive could go at such a pace … [It] had a sort of head at one end and then a series of about 30 pointed blobs, which dwindled in size as they neared the tail. As it went along, it seemed to get more and more submerged and then vanished" *[Anecdote 12]* (Harrison, 2001, p. 70).

The 1930s saw a continuance of sightings that described similar UMOs, some no doubt inspired by the "Nessie" mania of the time. In 1931, a rapidly swimming, 20-m-long UMO was seen "breaking the surface" in Suffolk (Figure 4). "At first they saw one black rounded hump which they thought was the head, and then a flatter second hump some way from the first. At times several intermediate humps appeared between the end ones, showing that it was indeed all the same animal … The head, which seemed to be round, and which swung from side to side, was about three times as big as a bather's would have been" *[Anecdote 13]* (Heuvelmans, 1968, p. 436). A Cornish UMO was seen in 1933 with "a little head and a series of small humps above the waves" *[Anecdote 14]* (Heuvelmans, 1968, p. 381). Three years later, off the Norfolk coast, four individuals spotted an UMO travelling at "terrific speed" and that "none of the ['five curved'] humps moved or changed shape at any time during the sighting" *[Anecdote 15]* (Harrison, 2001, pp. 64–65). As Harrison correctly notes, coming close to the real explanation of an entangled animal, "The appearance of the five curved humps, which according to the witness, maintained their shape throughout the incident, tends to indicate an archetypal sea serpent, a large snake-like mass moving through the water. Since there is no report of 'undulating movement' of the body, we can also glean that the creature must possess some other method of propulsion through the water." On the east coast of England, in 1938, an eyewitness was adamant that he observed a "sea monster" and not a school of marine mammals, stating that "no head was visible, but I saw quite clearly what appeared to be four or five half links of a partly submerged, huge snake-like body. It disappeared after about 5 min" *[Anecdote 16]* (Harrison, 2001, p. 58). Heuvelmans (1968, p. 458) refers to this as "a characteristic 'string-of-buoys' sea-serpent." Later in the same year and region, other eyewitnesses described seeing an undulating "strange fish of the sea" that "was dark, but not black, and there were several parts of it

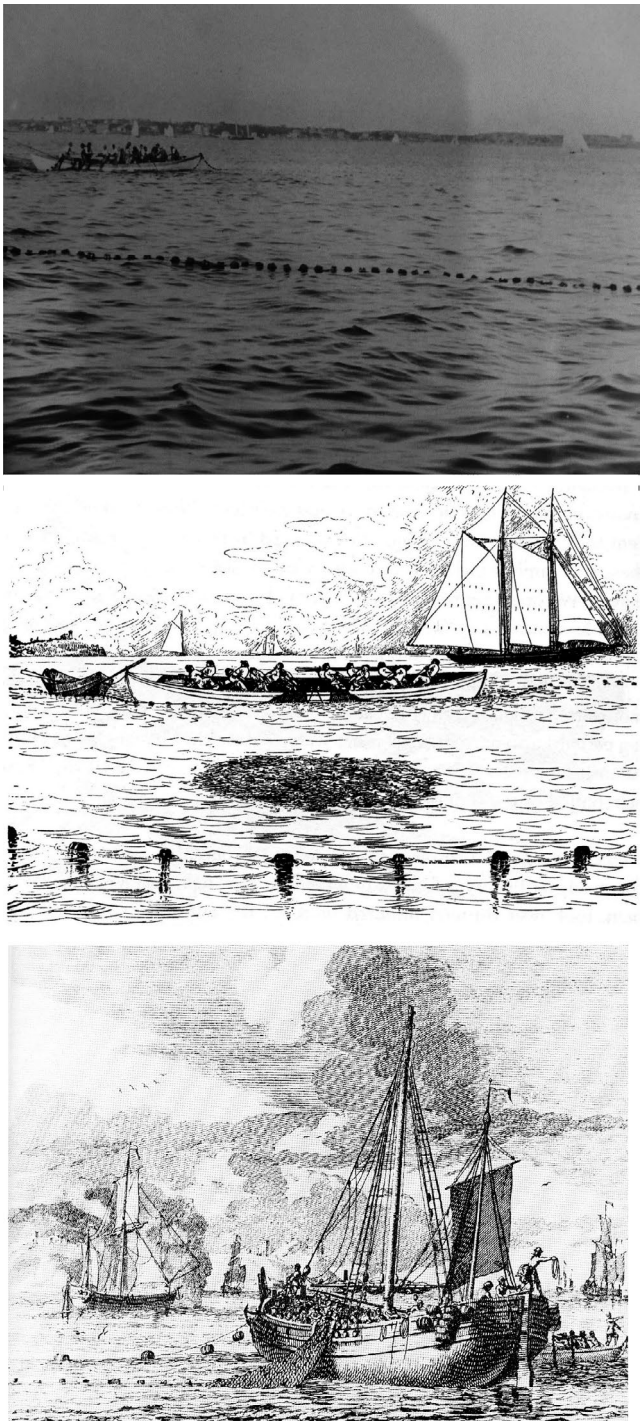

FIGURE 4 Strings of fishing net floats which, if non-lethally entangled around an actively swimming animal and bobbing up and down on the water surface, might be misconstrued to be the long tail of a presumed sea serpent, especially if also pulling a "mane" of intertwined fishing net and accumulations of seaweed or other natural or anthropogenic debris. Upper: cork pieces used to buoy a gillnet (photograph taken at the Cape Ann Museum, MA; from France, 2019b, 2020a); middle: casks used to suspend a purse seine (Goode, 1884; reproduced in France, 2019a, 2020a); and lower: double-tiered floats comprising the warp line of surface casks and the submerged net rope of smaller cork pieces of a "sunk" herring net (Samuel, 1918; also reproduced in Butcher, 2000)

sticking out of the water" *[Anecdote 17]* (Harrison, 2001, p. 75). And in 1939, on the east coast of Scotland, several individuals watched a rapidly moving 13-m-long UMO that created "a great swirling commotion in the water" and which had "several humps which ran along its back and which stood proud of the sea surface" *[Anecdote 18]* (Harrison, 2001, p. 75). This was no doubt the same UMO that had been described several days earlier by other eyewitnesses as being very flexible and having an undulating behaviour.

Several people observed an UMO moving rapidly and silently along the North Sea coast of England in 1945: "There we saw a creature with a head and four or five round humps, each of which was leaving a wake" *[Anecdote 19]*. Although brief, the anecdote is most interesting in terms of how it was interpreted by the compiler, Harrison (2001, p. 55), particularly in terms of how close he came to what was probably the truth:

> Cleary, this sighting cannot be ascribed to low-fling birds, as the witnesses claimed that they could see a wake being created by the movement of the creature in the water. The fact that each hump is described as creating its own wake would seem to indicate a number of different objects, since water displacement caused by the first object (the head and neck) would create a wake through which any following "humps" would pass, rather than creating their own wakes. The only way that this could have been a single creature was if the humps were a considerable distance apart, allowing displaced water to settle before they passed through it.

Harrison, however, stops short of continuing this valid assessment of the encounter to its logical conclusion of entanglement, instead suggesting that the agitation was caused by a school of porpoises. Finally, in 1949, another UMO was spotted off the Cornish coast which had "dorsal parts … [that] were ridged or serrated, similar to old pictures of Chinese dragons" *[Anecdote 20]* (Harrison, 2001, p. 94).

In 1963, when fishing gear in the British Isles was increasingly being made of synthetic material, an UMO was seen on the eastern coast of Ireland, with an eyewitness remarking: "I was watching two humps, one behind the other, moving forward slowly and regularly across the bay. It seemed to me like the back of a very large eel-like fish. I never saw the head or tail, but I would guess the humps were about five or six feet in length and the distance between them about eight or ten feet." *[Anecdote 21]* (Harrison, 2001, p. 226). Two years later, three individuals on the west Scotland saw what was first thought to be a seal until, that is, the subsequent emergence of other "very solid and dark and shiny" humps contributing to the 13-m-length of the UMO *[Anecdote 22]* (Harrison, 2001, p. 142). The following year, a couple were strolling along a North Sea beach when they saw "something like the Loch Ness monster" that noiselessly "skimmed through the water" 30 m offshore. The UMO "had a head like a serpent and six or seven pointed humps trailing" *[Anecdote 23]* (Heuvelmans, 1968, p. 536). Then, in 1980, the Cornish

sea serpent "Morgawr" was sighted again: "The first protrusion was about nine inches above the surface. Farther back, there was what might have been a hump and then another hump at about equal distance. Of course, it might have been a log, but it certainly moved closer and closer to the shore and then disappeared" *[Anecdote 24]* (Harrison, 2001, p. 100). Twenty years later, two caravan campers in the same area saw an UMO that "now took the form of defined humps, two of them very close together. I would think overall they measured about 15 ft … The humps were still … and a periscope-like object came out of the water very close to the humps. It was moving in a flexible manner, not at all rigid … I took the humps to be the back of a large body, the periscope-like object being a head and neck." The eyewitness went on to conclude that "I think the creature … is not one known to zoological science, but more to archaeologists who search for fossilized remains of creatures that existed many millions of years ago. This may sound stupid and far-fetched, but somehow I believe that some of them have lived on and exist in our waters. It wasn't a fish, more like a water-based dinosaur, like something you see in those 1960 films about prehistoric times" *[Anecdote 25]* (Harrison, 2001, pp. 103–104).

3.3 | Body "Hair"

The "head" of a 50-m-long UMO seen in Shetlands in 1882 was described as being covered with barnacles and sporting "whiskers seven or eight feet long" *[Anecdote 26]* (Harrison, 2001, p. 175). Off the East Anglia coast, in 1891, two people observed "the fins or large spines along the back of a sinuously moving creature of immense length." The UMO then raised its head above the water for a few seconds, and they noted it to have "shaggy brown hair or [a] mane flowing back from it" *[Anecdote 27]* (Harrison, 2001, p. 64). In 1893, an UMO was seen by a group of sailors near the Isle of Skye: "It was a large sea-monster—of the saurian type, I should think. It was brown in colour, shining, and with a sort of ruffled at the junction of the head and neck … I saw it move its head from side to side" *[Anecdote 28]* (Gould, 1930, p. 185). An 1898 sighting on the east coast of Scotland was of an enormous 60-m-long UMO of "terrifying appearance" with a "long tapering" head. Notably, its body "had a mane-like fin running down the full length of the back and breast. It was of a dark colour and unlike any monster we in a natural way could ever dream of" *[Anecdote 29]* (Heuvelmans, 1968, p. 363). Four years later and in the same general location, the crew of fishing boat encountered an UMO: "When the animal was 15 yards away, he fired at the head. Whether he hit it is not known, but it dived and a long sinuous body followed wriggling like a serpent but traveling at great speed. Long afterwards, the huge monster's undulations could be seen. He was twice the length of the *Glengrant* [their ship] or nearly two hundred feet. It had a head like a sea horse with a long mane or fin down the back" *[Anecdote 30]* (Harrison, 2001, p. 189).

Similarly described encounters continued into the new century. In 1907, off the coast of Cornwall, a 7-m-long "sea serpent" was observed whose head was situated above the surface and covered by "some kind of crest or mane upon it" *[Anecdote 31]* (Harrison, 2001, p. 108). In 1910, one UMO was spotted off the west coast of Ireland "showing a brown and hairy body" *[Anecdote 32]* (Heuvelmans, 1968, p. 384), and another seen the same year on the east coast moved through the water "as though someone had pushed an enormous tangle above the sea, substituting a horse's head for the leaves of the tangle." The eyewitnesses concluded that "it appeared to be a dark brown colour, which is the colour of tangle (kelp)" *[Anecdote 33]* (Heuvelmans, 1968, p. 386). In 1926, an UMO in Cornwall which had "managed to escape by tearing the nets" was described as having a back "covered in a matted brown hair" *[Anecdote 34]* (Harrison, 2001, p. 94). Two years later, this time off the Isle of Man, a "maned sea-serpent" with "sparse long whiskers" was observed *[Anecdote 35]* (Heuvelmans, 1968, p. 434). And in 1975, a Cornish UMO was observed "with what looked like coarse hair or bristles on it" *[Anecdote 36]* (Harrison, 2001, p. 95).

3.4 | Swimming motion

On the west coast Scotland in 1809, an observer described seeing an UMO "pretty low in the water" that was moving rapidly and "progressively by undulations up and down" despite the absence of fins *[Anecdote 37]* (Harrison, 2001, p. 141). In 1878, a group of geologists crossing the Channel to France observed a gargantuan UMO of 200 m in length: "Its elongated body was fairly on the surface of the water and it progressed with an undulating or quivering motion." They concluded that "the object before them could be nothing less than the great sea-serpent himself" *[Anecdote 38]* (Heuvelmans, 1968, p. 304). Four years later, a 65-m-long, many-humped UMO seen in Wales was described in the pages of the journal *Nature* as having motion that was "either cork-screw-like or snake-like, with vertical undulations" *[Anecdote 39]* (Heuvelmans, 1968, p. 286).

Continuing into the twentieth century, an UMO with "a long sinuous body … [that was] wriggling like a serpent" was seen in Scotland in 1903 *[Anecdote 40]* (Heuvelmans, 1968, p. 370). Nine years later, in Kent, another UMO, whose body was described with the same words, was observed to move "rapidly, apparently by undulations" *[Anecdote 41]* (Heuvelmans, 1968, p. 389). Then, in 1936, a 10-m-long UMO was seen swimming "swiftly" along the Norfolk coast by "skimming the surface of the water in a worm-like movement" *[Anecdote 42]* (Harrison, 2001, p. 66). Two years later, and further north, a "huge creature … with a flat head" was reported to move "along with a humped glide" *[Anecdote 43]* which Heuvelmans (1968, p. 459) interprets as "this clearly means that it moved with vertical undulations."

In 1971, a person holidaying in south-west England, whom would go on to emphatically state that he had neither been drinking alcohol nor was afflicted with eyesight problems, described seeing a 7-m-long UMO that exposed parts of its back while it moved forward "in an undulating or slithering-like motion [that] created an incredible wash and commotion in the water" *[Anecdote 44]* (Harrison, 2001, p. 93). The observer mentioned that he was an experienced fisherman and

that "never have I seen something like this. If it didn't sound so stupid and I didn't know better, I would say that it was a form of hybrid eel, but at 20 feet? It can't have been, there's no eel on record that size, there must be a more rational explanation, but I'm damned if I know what it is!" And on the west coast of England, 7 years later, several people discerned "a curious long curly shape [with 'three humps'] emerge on the surface … [that] through the naked eye seemed to wriggle" *[Anecdote 45]* (Harrison, 2001, p. 117).

3.5 | Other behaviours

In 1,850, an Irish UMO was fired upon by a double-barrelled gun "without effect" *[Anecdote 46]* (Harrison, 2001, p. 91). And in 1903, an UMO came so close to a ship on the east English coast that "one of the men 'hit his body with a belaying pin, and it sounded as if an iron tank had been struck'" *[Anecdote 47]* (Heuvelmans, 1968, p. 370).

In 1896, the crew of an East Anglian fishing boat saw a "huge monster" of 100 m length that "resembled three enormous half circles in line, each being 10 feet high and 50 feet long, and there was room between each circle for the lugger [i.e., a small boat] to have passed. Still making the same noise [likened to that of 'a big steamer cutting her way through the water'], it passed close under the lugger's stern" *[Anecdote 48]*. Harrison (2001, p. 69) is much puzzled by this sighting: "It is difficult to understand how a creature, which, when it rose, was only 60 ft from the vessel, could mange to expose three semicircular humps each measuring 10 × 50 ft then completely submerge in order to pass under the lugger."

An UMO of serpentine form, 7 m long and only a third of a metre wide, was observed in 1912 in south-west England "that seemed to be in conflict with another sea animal, as it was violently whipping the water with its tail as though agitated by something below the water" *[Anecdote 49]* (Harrison, 2001, p. 91).

Observers in Suffolk in 1931 saw an "object" shaped like a man's head and with a "great length of snake-like body behind" that was moving rapidly on top of the water (Figure 3). Most remarkable what the "monster" did next: "Meanwhile the length of its body was across the sandbank with the tail end still in the water on the beach side—it then ceased beating on the sea and the whole body was pulled over. It was incredibly long … It was a marvellous sight and the agility with which the monster crossed the sandbank makes me realize they are not completely helpless on land" *[Anecdote 50]* (Harrison, 2001, p. 77). Harrison supposes that the animal to have been a pinniped but is at a loss to explain the elongated tail. Another amphibious sighting took place in Scotland in 1851. An UMO was observed by "a venerable lady" swimming next to the shore and causing small fish to leap out of the water in front of it. Then, the UMO "thrust its head and some eight or ten feet of its body up on the rocks where it rested for some time till the shore boats approached, whereupon it slid into the water and disappeared seawards, leaving a long wake or furrow behind it" *[Anecdote 51]* (Heuvelmans, 1968, p. 338). Heuvelmans recounts that some fishermen later visited the location and collected "some alleged sea-serpent scales … about the size and shape of a scallop shell, which were found on the reef of rock in the bays whereon the monster had comforted itself by scratching its head."

3.6 | Assembling the composite cryptid

The 51 anecdotes from the British Isles that contain descriptions of attributes similar to those reported for the famous Gloucester UMO vary in the amount of useful information they purvey. As the case for all "sea serpent" sightings, credibility differences exist (Champagne, 2001; France, 2019a), and are to be expected, a reflection of the particulars about the sightings themselves, variability among eyewitness experience and idiosyncrasies concerning the documenting of accounts (Paxton, 2009; Paxton & Shine, 2016). With respect to the 13 attributes examined herein, two anecdotes contained descriptions of 5 of the attributes, 6 anecdotes contained descriptions of 4 of the attributes, 14 anecdotes contained descriptions of three of the attributes, 16 anecdotes contained descriptions of two of the attributes, and another 16 anecdotes contained descriptions of only a single attribute.

In toto, a notable anatomical feature of the examined UMOs from the British Isles is their considerable length (anecdote 21), ascribed by eyewitnesses to various sizes, including less than 10 m (anecdotes 31, 44, 49), between 10 and 20 m (anecdotes 2, 10, 12, 13, 18, 22, 42), and to more than 40 m (8, 26, 29, 30, 38, 39, 48). Bodies are frequently referred to as being elongated and serpentine in form (anecdotes 1–5, 6, 16, 30, 38, 40, 41, 44, 49, 50). Tellingly, and most notably, much of the lengths of the UMOs are composed of overt series of irregular or uneven body parts in the form of a dorsal ridge (anecdotes 9, 10, 13, 14, 20, 21, 27, 39), that are often variably described as "humps," "coils" and the like, and are of variable number, ranging from two to three (anecdotes 6, 8, 17, 18, 21, 24, 25, 45, 48), to four to seven (anecdotes 11, 15, 16, 19, 23), to around a dozen (7), and even up to 30 such (12). Bodily features are occasionally likened to resembling casks or scales (anecdotes 3, 11), and significantly, eyewitnesses frequently remark on the conspicuous presence of long strands of material, interpreted as being "hair," "whiskers" or a "mane" (anecdotes 26–36).

A notable behavioural feature of the British Isles UMOs is their rapid speed of movement (anecdotes 12, 13, 15, 18, 23, 30, 37, 41, 42, 50), which frequently is accompanied by considerable water disturbance (anecdotes 7, 11, 19, 44, 48, 51). Observations reveal that elongated UMOs displayed themselves on the surface of the water with high degree of flexibility (anecdotes 2, 3, 18, 45), and most notably, that their body components independently moved through vertical undulations (6, 9, 11, 17, 25, 27, 30, 37–45). When not moving slowly or floating motionless upon the water (anecdotes 7, 13, 21, 25, 28), sometimes the extended bodies of UMOs were seen to suddenly disappear beneath the surface (anecdotes 7, 11, 12, 24), or, in one case, to thrash about as if in distress (anecdote 49). Portions of UMOs observed above the sea surface sometimes seemed oblivious to surroundings, even including

when passing right underneath a ship (anecdote 48), as well as being struck with bullets or bludgeoned (anecdotes 46, 47). Most remarkably, occasionally body sections were seen completely out of the water and draped over the intertidal seashore (anecdotes 50, 51).

4 | DISCUSSION

4.1 | Anecdotal reinterpretations as evidence for early entanglement in the British Isles

The UMO now known as the "*Leda* sea serpent" was observed by more than a dozen people over a 5-day period in at least ten different locations off the coast of Skye in 1872 and was first reported on in the journal *The Zoologist*. The lengthy eyewitness descriptions and illustrations of the slow-moving, many-humped and headless UMO clearly denote an animal—probably a basking shark—pulling a chain of entangled fishing floats across the surface of the water (France, 2019b; Figure 3). A nearly identical sighting of an UMO from the vessel *Kätie* that occurred a decade later in the same region even more closely insinuates the same, as, in this case, a dorsal fin was displayed (Figure 3) in the typical manner of surface-feeding basking sharks, as famously shown in the classic 1934 docudrama, the *Man of Aran*. The present archival examination of the complete corpus of "sea serpent" anecdotes from the British Isles indicates that sightings of putatively entangled animals are by no means phenomena unique to only the Scottish Hebrides or restricted to the Late Victorian Period.

With sizes approaching 30 m in length, the blue whale (*Balaenoptera musculus*, Balaenopteridae) is largest animal to have existed, whereas the bootlace nemertean worm (*Lineus longissimus*, Lineidae), at up to 55 m, is the longest. The overt bulk of the former, and the miniscule width of the latter, precludes them as likely candidates for being misconstrued as sea serpents in the British Isles. Furthermore, the considerable lengths reported for most of the observed UMOs are incongruous with what is known of the body sizes of marine megafauna (McClain et al., 2015) and their occurrence in the region's waters. Clearly, something completely unnatural must be going on, as there are simply no suitable candidate animals that approach such proportions and have extremely narrow bodies described as resembling those of snakes or eels. As shown in Table 2, these observed attributes of UMOs from the British Isles agree with those of the Gloucester UMO (France, 2019a) and others from North America (New England and Atlantic Canada) and the Western Pacific Ocean (France, 2019c, 2020a, 2020b), which have been proposed to have been entangled animals. The same concordance demonstrated between attributes described for British Isles UMOs and those

Attribute	British Isles	Nova Scotia	New England	Western Pacific
Notable length	21	11	9	20
Body composed of a series of irregular, jointed component parts (multiple humps, coils or a ridge)	24	7	9	15
Rapid speed of movement	10	5	3	4
Notable flexibility of body	4	3	1	1
Vertical undulating movement of body segments	24	5	3	10
Body components likened to kegs or barrels, and sometimes scales or saucers	2	8	2	6
Oblivious of surroundings or impervious to disturbance	5	4	2	3
Overall body likened to a string of floats, kegs or buoys	0	3	3	0
Obvious trailing wake or water disturbance	6	6	2	6
Floating motionless, gently swaying in waves or moving very slowly	5	1	2	6
Narrow, tapering, sinuous, snake/eel-like shape, often with absence of a caudal fin or lateral appendages	14	8	3	15
Extended body pulled down into water, thrown up into the air or thrashed about on the surface	5	0	1	3
Presence of a horn, spike, spine, mane or other protuberance (sometimes identified as a head)	11	3	2	9

TABLE 2 Observed physical and behavioural attributes of unidentified marine objects (UMOs) posited to have been entangled animals. Attributes are those used to describe the UMO observed in and around Gloucester in 1817, and clearly indicative of an animal entangled in marine debris (France, 2019a). Numbers shown indicate the incidence of occurrence for 51 different sightings around the British Isles between 1809 and 2000, 12 different Nova Scotian sightings between 1787 and 1939 (France, 2020a), 20 different sightings in New England between 1831 and 1925 (France, 2019c), and 28 different sightings in the Western Pacific between 1854 and 1962 (France, 2020b)

for the different sets of regional observations imply a consistent explanation.

As the case for UMOs from North American and the Western Pacific, those observed in the British Isles have also been described as having body components that signify entangled debris. One anecdote refers to a cask-sized body, while another describes the body being covered with scales. Then, there was the intriguing report wherein later visits to a shore revealed the presence of "sea-serpent scales" where the UMO had been seen "scratching" itself. As previously mentioned, both casks and glass balls were customarily used as floats on herring nets throughout the nineteen century, an hypothesis which can be invoked to parsimoniously explain these accounts.

Unlike the situation for UMOs described in North America but similar to the case for the Western Pacific, none of the anecdotes concerning "sea serpents" in the British Isles specifically mentioned the overall body to resemble a string of floats, kegs or buoys (Table 2). Nevertheless, some of the most telling evidence supporting the illation that these UMOs observed in the British Isles, and hitherto believed to have been fantastic beasts, were merely mundane animals with the misfortune of being entangled, comes from parsing descriptions of the physical attributes of the so-called body "humps" and "hair."

It is simply physically impossible for the body of any animal noted for displaying marked flexibility to be composed of a series of humps or coils that are elevated *above* the surface of the water, with this rigid form of separated units and corresponding interstitial water being maintained during forward motion. Moreover, the remarkable fact that the body segments sometimes displayed such a "strange crenellated back" formation even when the animal was at rest proves beyond doubt that the protrusions cannot have been biological in nature. In one instance, the "enormous half circles" were elevated above the surface to such a height that a small boat could pass through the spaces. Obviously, these loops cannot have been biological in nature, but were rather of some type of maritime debris, the same sort that one can observe today in online photographs of poor animals pulling all manner of anthropogenic bric-a-brac. Then, there are the reports of long, shaggy filaments believed to have been whiskers or manes of hair flowing or draped about the backs of UMOs, in one case likened to attached mats of kelp, which of course bespeak entangled fishing nets.

The frequent mention made of rapid motion in UMOs from the British Isles is similar to observations from elsewhere (Table 2), and provides confirmatory evidence that what was being seen must have a non-biological explanation. For, in the absence of overt fins or discernable tails, it is quite simply impossible for a eel-shaped animal relying upon nothing more than vertical undulations to be able to generate the hydrodynamic forces necessary to achieve such fast movement (van Weerden, Reid, & Hemelrijk, 2013). Clearly, the agent of propulsion must lie elsewhere, as for example entangled animals at the front end of the debris trains and invisible (either temporarily or permanently) beneath the surface. Moreover, marine animals of noted mobility have evolved body shapes designed to reduce drag as much as possible. The fact that descriptions of the motion of UMOs observed in the British Isles were associated with considerable water disturbance, which in several cases was noted to be produced separately by each individual body hummock in sequence, once again denotes a non-biological causality. Finally, of course, the worm-like wriggling motion remarked upon by eyewitnesses occurred in the vertical plane, antithetical to the horizontal flexure used for propulsion by fish, including those having narrow, elongated bodies such as sea snakes (which are completely absent from the Atlantic Ocean anyway).

Observations that UMOs from the British Isles were often seen resting motionless upon the surface, sometimes followed by quick submergence, suggest that, at least in these cases, the animal at the front end of the entangled train of fishing gear was probably a large fish (France, 2019a). Descriptions of what were imagined to be "heads" looking about every which way are exactly how barrel floats with attached flagpoles used to mark the ends of herring nets (see museum photographs in France, 2019a) behave when swaying in the waves.

Similar to the situation with regard to North American and Western Pacific UMOs, those from the British Isles also displayed a notable inattention to their surroundings and an imperviousness to physical assault (Table 2). One anecdote mentions the train of humps being submerged underneath a ship with no apparent upward resistance as would be expected should the train of components been part of an actual body. In another anecdote, the tail of an UMO was seen violently thrashing about on the surface. The literature on aquatic mystery animals is rife with similarly described incidences. In some cases, these have been interpreted as animals being locked in mortal combat with imagined sea serpents, but which are parsimoniously probably the earliest observations we have of marine animals struggling to free themselves from entangled fishing gear (see descriptions and illustrations in France, 2016a, 2017), the sort of dramatic encounters which today make for painful reading (e.g., Johnson, 2005). Several instances occurred wherein UMO bodies were actually seen to be draped over dry land in an amphibious fashion unknown to any large serpentine marine animals in the region, again, plainly evidence for the unnaturalness of these chimera creatures. And finally, perhaps the most compelling evidence that the long tails of British Isles' "sea serpents" are really human artefacts comes from several anecdotes mentioning that the observed UMOs registered neither being clubbed nor struck by shotgun blast. The fact that the former encounter elicited a loud noise "such as when an iron tank had been struck" indicates the non-biological nature of the material.

It is generally a much easier task to reach an illation that certain sea serpent sightings represent evidence for early entanglement than it is to discern the actual identify of the unfortunate animals at the front end of the debris chains. Based on the information purveyed in illustrations and anecdotes from eyewitnesses, some cases, such as those of the *Leda* and *Kätie* sightings from Scotland, seem straightforward (France, 2019b). Other examples, such as the Gloucester and Egede UMOs, are more elusive and require detailed screening of the candidates (France, 2019a, 2021), in a manner similar

to what has been described as the "detective work" (McClenachan, 2015) or "forensic pursuit" (Alexander et al., 2017) that is sometimes necessary in historical ecological research. For the present investigation of the British Isles, the most likely suspects for antecedent entanglement are the same as those which have been hypothesized previously as explanations behind "sea serpents" in other locations: cetaceans (Fama, 2012; France, 2016b, 2018; Heuvelmans, 1968), chelonians (France, 2016c, 2017), large fishes (de Camp & Crook de Camp, 1985; France, 2019a, 2019b) and pinnipeds (Cornes & Cunningham, 2019). Notably, these are all animals recognized today for being highly susceptible to fishery by-catch and entanglement (Laist, 1997; NOAA, 2014).

4.2 | The wider context of the monstrous Anthropocene

At first blush, it might seem odd that so many eyewitnesses could mistake entangled fishing gear for the body of a sea serpent. However, it takes but a brief glance at nineteenth-century fishery illustrations and photographs of long strings of net floats (Figure 4; other examples shown in France, 2016a, 2016b, 2016c, 2017, 2020a) to realize that if seen at a distance, possibly festooned with strands of matted netting or kelp to give an impression of solidity, and bobbing along atop the surface of the water in an undulating motion while accompanied by water disturbance created through being pulled behind an entangled animal, that it would certainly not be surprising for an observer's expectant confirmatory bias to kick in and a conclusion reached that it was indeed a classic sea serpent that was being glimpsed. The scientific opinions and societal mindsets of the nineteenth century concerning beliefs in the existence of sea serpents were persuasive in terms of the former and pervasive for the latter (France, 2019a; Lyons, 2009). In this regard, it is "believing is seeing," rather the other way around, the process through which science operates (France, 2019a). There are in fact many examples of nineteenth-century mariners and fishermen having experience in observing all manner of sea life who were fooled by accumulations of anthropogenic debris and accompanying organic matter (see France, 2018, 2020a for one such example). And in another remarkable case, it was not until the putative "sea serpent" had actually been successfully captured, hauled on board the ship and closely examined that the UMO was determined to be a nothing more than a mass of netting covered in periphyton. Eyewitnesses can therefore be forgiven for imagining their sometimes fleeting glimpses made of entangled UMOs were sightings of the fabled "Great Sea Serpent" documented by Oudemans (1892), and many respected scientists before him (Westrum, 1979). Given the strength of such engrained belief systems, it quite literally possible to conjure sea monsters from out of the very air itself through optical illusions caused by atmospheric refraction (Lehn, 1979; Lehn & Schroeder, 2004).

The question then arises that if some UMO sightings derive from observing entangled animals, why have not reports of sea serpents increased in tandem with the widespread use of plastics in fisheries? The reason for the disjuncture is a fascinating and complex sociological story that is beyond the immediate scope of the present historical ecology analysis, but which concerns how changes in knowledge acquisition and popular faddism have conjoined to create the recurring cyclical pattern in the prevalence of UMO sightings from early nineteenth-century natural history to present-day cryptozoology. Topics behind this periodicity include religious beliefs, palaeontological discoveries, evolutionary theories, geographic exploration, popular films, nature documentaries and anti-scientific fundamentalism (Dendle, 2006; France, 2019a, 2020b; Loxton & Prothero, 2015; Lyons, 2009; McGowan-Hartman, 2013; Mitchell, 1829; Paxton & Naish, 2019; Westrum, 1979).

The word "monster" derives from the Latin word *monstrum* which itself denotes warning. There is a long history of monsters in general (Asma, 2009), and sea monsters in particular, functioning as omens portending turbulent times. Long thought to be a cautionary warning about scientific hubris, Mary Shelley's Creature has recently been reinterpreted as a metaphor for the physically ravaged hordes of wandering refugees during Europe's last major subsistence crisis during the "Frankenstein weather" of the extreme climatic upheaval caused by the eruption of Tambora (Higgins, 2016; Wood, 2016). In New England, the ensuing famous "year within a summer" triggered a sequence of resource adaptations that had a marked impact on the regional SES. Slaughter of livestock from want of fodder and the collapse of the anadromous fishery due to spawning failures necessitated a resource shift to mackerel (Alexander et al., 2017). The result was the sudden and massive deployment of fishing gear in offshore waters, which, in turn, led to the non-lethal entanglement of an animal, probably a large fish, and the consequent folkloric invention of the Gloucester Sea Serpent (France, 2019b).

The corresponding shift from riverine to marine fisheries in northern Europe in general (Hoffman, 2005), and England in particular (Barrett, Locker, & Roberts, 2004), occurred much earlier and over a more prolonged period. Of interest is that the expanded deployment of offshore fishing nets was coincident to the flurry of cartographic depictions and textual descriptions of sea monsters (France, 2019a). Given that the nineteenth-century population of the British Isles was more than 20 times that of New England and Atlantic Canada, it is not unreasonable to conclude that there would have also been a concordant disparity in the extent of fishing equipment set along their respective shorelines. Correspondingly, the opportunity to conceptually create sea serpents in the British Isles from misconstrued sightings of entangled animals would have been relatively higher. This is reflected by the fact that, through using the same selection criteria of qualitative coding when examining anecdotes, the prevalence of all purported sea serpents that can be deduced to have been entangled animals is about a quarter for the British Isles, an amount that is higher than the 15% inferred likewise for North America (France, 2019b, 2020a) (but is less than the 40% so estimated for the Western Pacific (France, 2020b), about which one might speculate has always had greater fisheries for sustaining higher regional populations).

The present anecdotal research posits the habitual early entanglement of marine life in the waters of the British Isles based on indirect evidence garnered through a reinterpretation of "sea serpent" sightings. This supports other explicit, albeit much rarer, accounts from the region of animals, such as basking sharks, that were explicitly mentioned to become entangled throughout the nineteenth century (reviewed in France, 2019a, 2019b). Clearly, entanglement in the British Isles has a prolonged antecedence that is unrelated to the fishing industry's switch (Butcher, 2000) from hemp to cotton during the nineteenth century and to plastic monofilament in the 1950s and 1960s. In this light, the present investigation joins that of Thurston et al. (2014) in showing that eyewitness testimonies can provide insight about the fishery pressure experienced by marine fauna in the British Isles during the nineteenth century.

The present investigation provides credence for an illation in the general ubiquity of early, pre-plastic entanglement. Heuvelmans (1968) concluded his seminal work with a set of maps indicating, in his opinion, the broad geographic distribution of sea serpent/monsters. Five "hotspots" of numerous sightings can clearly be identified, which, in order of decreasing prevalence, are northern Europe (British Isles and Norway), followed by the north-eastern seaboard of North America (New England and Atlantic Canada), and then the Western Pacific (Australasia, Indochina, Indonesia), the Pacific north-west of North America (British Columbia and Washington State) and finally the southern African continent (particularly South Africa). Deductions that a not-insignificant proportion of these numerous UMO sightings can be parsimoniously explained (i.e., through Occam's Razor–Das, 2009) as being unrecognized animals that were non-lethally entangled have now been made for three of the regions: Northern Europe (this paper), north-eastern North America (France, 2019c) and the Western Pacific (France, 2020a). When combined with other reinterpreted sightings of selected and famous UMOs spanning locations as separated as Saint Helena, the Great Barrier Reef, the Cape of Good Hope and Brazil in the Southern Hemisphere (de Camp & Crook de Camp, 1985; France, 2016b, 2017, 2018) and Sicily, the Scottish Hebrides, Norway, Greenland and Alaska in the Northern Hemisphere (France, 2017, 2019b, 2021, in prep.), entanglement during the nineteenth century can be surmised to have been a truly global phenomenon.

Marine environmental historians have demonstrated damage to fish stocks in consequence of long-term harvesting pressures (e.g., Bolster, 2012; Fagan, 2017; Jackson et al., 2011; Kittinger et al., 2015; Rick & Erlandson, 2008). The significance of the present environmental history is its suggestion, based on examination of anecdotal evidence compiled from eyewitness encounters with purported sea serpents, that marine fauna in the British Isles have been subjected to pressure not only from direct fishery exploitation (e.g., Hodgson, 1957; Samuel, 1918; Starkey, Ramster, & Reid, 2000) but also from being by-catch due to entanglement in that deployed gear for a much longer period than is commonly presumed, that is extending back at least for several centuries. As one reviewer of the presentation of this theory cogently summarized: “This argument goes to the continuity between old and new techniques, and the fact that new techniques only extend and amplify the effects of older ones. This argument tones down the narrative of a destructive modernity as distinguished from a glorified past.” Comprehensive understanding of the historical impacts of fisheries should therefore address both species that are directly exploited as well as those which may become incidental victims. In other words, there is a parallel environmental history concerning the collateral damage of fisheries that needs to be part of the overall story of Anthropocene change.

DATA AVAILABILITY STATEMENT

Full texts of the historical anecdotes presented in this paper, as well as some contextual information can be found in Heuvelmans (1968) and Harrison (2001).

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